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REDUCING LOGGING DAMAGE 1/

By Richard D. Cosens, Forester,
Division of Forest Management Research

Reducing logging damage to reproduction and residual stands is an important part of harvesting the old-growth forests of California. Much of the overmature timber is on areas with an acceptable stocking of advance growth. When the old trees are harvested, the advance growth is scarred, deformed, broken, or killed outright. Insects and disease attack the broken and scarred trees, and the quantity and quality of wood grown for the next harvest is reduced. Sometimes the advance growth is so severely damaged that the stand must be regenerated. This is costly and of course extends the time that land owners must wait until the next harvest.

The extent of damage varies with stand conditions, forest types, topography, type of equipment, and attitude of the loggers. The more frequent sources of damage are:

1. Unnecessary and improperly located roads, landings, and yarding trails.

2. Improper falling.

3. The use of tractor-arch units in young stands.

4. Loose supervision of logging crews in their efforts to reduce damage.

1/ The plan for reduction of logging damage was made and carried out under the direction of W. E. Hallin, in charge of silvicultural investigations, Division of Forest Management Research. Acknowledgment is made to David C. Maul, formerly of the Division, for the use of material from progress reports made while he was carrying out the plan in the field.

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A general policy of careful logging is not enough to reduce damage; besides the policy, specific measures must be designed to do the job. This article describes the measures taken to reduce logging damage on an experimental logging project conducted by the Experiment Station in 1948 and 1949. The logging project was part of a trial application of Dunning's Unit Area Control[2] to the sugar pine-fir type, common on the west slopes of the Sierras in central California. Logging was done by Experiment Station crews.

The Logging Project

The trial was carried out on 200 acres of the Stanislaus Experimental Forest, about 30 miles east of Sonora, California. The topography ranged from relatively level areas to steep slopes. The forest was composed of many small unit areas, or natural groupings of trees. Each unit was uniform in age, species, and stocking; and enough different units were present to classify the forest as a whole as an all-aged, mixed-conifer stand. Unit areas containing advance growth occupied 70 percent of the logging area and were of three general types, each requiring a different silvicultural treatment in the first cutting cycle. Groups of young trees with no overstory received no cutting. Groups of reproduction with an overmature overstory received a group release cut. And groups of mature and immature trees with a few scattered overmature trees received an improvement cut. For these three types of areas the cut averaged 6.6 trees, or 29,000 board feet per acre, and the reserve averaged 60 trees, or 46,000 board feet per acre. The reserve also included numerous poles under 11.6 inches d.b.h. The other 30 percent of the area consisted of groups of overmature trees, in units of one-fifth to 3 acres in size, with inadequate stocking of advance growth. These areas were clear cut and the ground was prepared for regeneration by bunching the brush and slash and exposing the mineral soil with a bulldozer.[3]

The measures used to reduce the logging damage on this project are discussed under three headings:

1. Advance planning,

2. Carrying out the plan, and

3. Training and supervision.

2/ Hallin, William E. 1951. Unit area control in California forests. California Forest and Range Experiment Station. Forest Research Note No. 77. 8 p. Berkeley, Calif.

3/ Gordon, Donald T., and Richard D. Cosens. 1952. Slash disposal and site preparation in converting old-growth sugar pine-fir forests to regulated stands. California Forest and Range Experiment Station. Forest Research Note No. 81. 7 p. Berkeley, Calif.

Advance Planning

A logging plan was made before actual logging started. Much of the planning was done as the timber was marked for appropriate silvicultural treatments. This made it possible to coordinate forestry and logging phases of the operation, eliminating the need to adjust road or landing locations after logging began. Thus, the plan resulted not only in less damage to the young trees but also in a more efficient operation. Preparation of the plan was done in four steps: (1) Locating secondary roads and landings, (2) marking timber and selecting yarding methods, (3) preparing logging maps, and (4) outlining cutting patterns.

Roads and Landings

Tentative locations for secondary roads, landings, turn-arounds, and the area to be served by each landing, were first determined from aerial photographs and a topographic map. Then when the logging area was checked on the ground, the final locations were marked on a map and on the ground. The logging superintendent and a forester worked together in selecting these locations.

Coordination of the road system with the rest of the logging plan was the most important feature of road location as far as reducing logging damage was concerned. Secondary or spur roads were located so that disturbances to the reserve stand and to the ground were minimized. Roads were routed through natural openings, and cuts and fills which might erode were avoided when practicable.

Each landing was located so that the main yarding trails entering it would do a minimum of damage to reproduction and to stream channels. Natural openings in the timber were utilized. Locations were made to tie in with the existing road system, so the landing was on the edge of a secondary road if possible. For safety reasons, landings were not placed on roads having through-traffic from other areas. Some of the landings used in the first cut were located for permanent use in order to minimize both the area made unproductive by landings and spur roads and the cost of future construction.

The area to be yarded to each landing was determined by the topography, yarding distance, location of the landing itself, and the location of adjacent landings. The desired maximum yarding distance was 1,200 feet, but in some cases distances up to 2,000 feet were necessary because of the topography. To avoid erosion hazards, boundaries of each setting were laid out so that yarding trails would not cross small streams. Thus streams as well as ridges affected the location of setting boundaries. For example, in 1948 two landings were located relatively close together, one on the north side of a stream and the other on the south side.

Marking and Yarding Methods

Marking was done by a two-man crew. One man selected the unit areas that were to be cut for regeneration, group release, or stand improvement. He marked and numbered the trees, located and flagged the arch trails, and made the necessary tree measurements. On unit areas marked for group release or improvement, he also designated the places where ground skidding should be used instead of arch yarding. The other man recorded tree data and made a rough map of the landing area. They began work at the landing, thus making it easier to select arch trails as marking proceeded away from the landing. The logging superintendent and the forester checked the arch trails and ground skidding area before logging started at each setting.

Arch-trail locations were determined by five main objectives. First, the trails serviced the entire landing area so there would be no reason to make additional trails at the time of logging. Second, the number of trails was kept to a minimum, with branch trails joining the main ones as soon as feasible. Third, stream crossings were kept to a minimum by locating arch trails on both sides of the stream where it was impracticable to locate separate landings. These trails were located as far away from the stream edge as practicable in order to minimize disturbances on or near stream banks. Fourth, patches of reproduction were avoided by running the arch trails through natural openings, or openings resulting from cutting. Trails were routed around young stands where there was to be no cutting, and occasionally short adverse grades were accepted to avoid patches of reproduction. Fifth, the trails were located to avoid long or steep adverse grades, unnecessary distances, and sharp turns. The trails were marked on the ground by flagging trees and bushes with strips of paper or cloth. Occasional trees that could not be avoided when locating trails were marked for cutting. The trails were rechecked when the marking was completed to make sure they were located properly in respect to the objectives and in relation to other trails. Tractor-arch units were confined to these trails except for the actual pick-up of logs. Use of these designated trails contributed much to the reduction of logging damage.

Ground skidding was designated for areas containing reproduction or advance growth that would be severely damaged by the maneuvering of a tractor and arch. This included most of the unit areas marked for a group-release cut and several of the unit areas marked for an improvement cut. Since many loggers are prone to consider dense, small reproduction as brush, special care was taken to designate these spots for ground skidding. Slopes too steep for the tractor and arch were also marked for ground skidding. Within all ground-skid areas logging was done with a skid cat.

Regeneration cuts, as mentioned previously, were made on unit areas having overmature trees with little or no advance growth. All trees on these unit areas were marked, and the boundaries of the areas were plotted by the mapper.

In 1948 the direction of fall was marked by a painted line on trees to be cut, so advance growth would not be damaged. This practice was later discontinued because the same objective was adequately achieved by crew training and supervision, with a considerable saving of time.

Logging Maps

Logging maps similar to the one in figure 1 (at end of paper) were prepared for all landings. As marking progressed, the mapper sketched in the details. Relative, rather than exact locations were plotted. Details mapped were roads, streams, rock outcrops, landings, arch trails, regeneration units, places where ground skidding was necessary and the trees marked for cutting. For the regeneration unit areas, only the numbers of the first and last tree were plotted. Where the marked trees were not grouped, the position of each tree was plotted. The maps were duplicated by the ozalid process for distribution to loggers.

Cutting Pattern

A cutting pattern for each landing was also prepared in advance of logging. This was done to prevent any conflict between yarding and cutting that would necessitate new arch trails and landings or that would lower safety standards by having the two crews too close to each other. Using volume data from marking sheets and tree locations from logging maps, cutting strips were drawn on the map and numbered for cutting priority. The first strip to be cut included the trees near a main arch trail. The objective was to finish the cutting on an area adjacent to an arch trail before yarding began. Basing the cutting strips on arch trails in this way permitted a more even daily production by balancing long skids with short skids. The first cut on areas to be cut in two stages was designated for cutting as soon as possible. Then this cut could be yarded, and the second cut and yarding completed before the landing was moved.

On logging operations where falling is completed on an entire setting before yarding begins, a planned cutting pattern is necessary only for areas that are cut in two stages.

Carrying Out the Plan

Copies of the landing-area maps were distributed to each set of fallers, the head rigger (called head choker setter on some operations), the skid-cat choker setter, the logging superintendent, and the forester. Besides marking the trees for cutting, the forester trained and supervised the logging crew on the planned methods of reducing logging damage. Each man receiving a map was shown by the forester how he could use it most advantageously.

Use of Maps

The fallers made use of the maps in two ways. When falling a tree they knew the location of the arch trail and were able to place the tree so that yarding could be done with the least amount of damage. Many times the location of the arch trail was the controlling factor in determining the direction of fall. Of course other factors--such as the lean of a tree, the risk of breakage in falling a tree over windfalls or rough ground, and the risk of damaging advance growth--also influenced the direction of fall. Regardless of the other factors, on steep slopes the trees were dropped up or down the hill, rather than across the slope, in order to prevent damage to advance growth from rolling logs and to reduce the accident hazard for the yarding crew. The maps also aided the fallers in locating marked trees and made it unnecessary to check whether isolated trees were marked. Only one tree out of approximately 2500 marked was missed by the fallers. It was felt that the map and the practice of numbering the trees were responsible for this excellent showing.

The yarding crew found that the maps made it easier to follow the arch trails and to determine which trail the logs should be yarded to. This can best be illustrated by referring to the map in figure 1. Assume that the yarding is proceeding in a clockwise manner and that the trees numbered 53 to 56 are being yarded. The map shows clearly that the next group, trees numbered 47 to 52 should be skidded to another trail rather than the one now being used. The reason for using another trail is that a patch of reproduction grows between trees 49 to 53. Had the map not been used, this patch could have been partially destroyed by running an arch trail through it. The crew could also see where ground skidding was necessary, so the forester did not have to be constantly with them.

The logging superintendent found the maps valuable in directing the yarding crews. Instructions were clearer when referenced to the map, and yarding distances were more easily balanced. He was also able to determine when and for how long it would be necessary to use the skid cat at each setting. And the forester found the maps useful in checking the crews to see that they were following the logging plan.

Two-stage Cutting

Logging was done in two stages to reduce breakage and damage to the residual stand where a large volume of timber was removed. This was necessary on about 30 percent of the area, primarily the regeneration units. The fallers first cut from 50 to 60 percent of the marked trees on these units and all the marked trees on the rest of the area. After these logs were yarded the remaining trees were cut. This practice also lowered the time needed for limbing and bucking. The volume removed on each cut was always more than 20,000 board feet per acre, and logging costs per thousand were not increased by two-stage cutting. The cutting

pattern was arranged so that both stages of logging could be done without moving landings. To do this, the fallers were assigned to cutting strips in the two-stage areas as soon as the trees around the landing and main arch trails had been felled.

Use of Skid Cat

Ground-skidding areas were logged with a skid cat rather than the tractor-arch unit. The skid cat had a smaller turning radius and greater maneuverability and consequently did far less damage to the advance growth than the tractor-arch unit. With the skid cat it was possible to yard individual logs down the line of the tree. This was done by pulling out the first log to an opening, then backing down the line of the tree to the next log, and so forth, until the entire tree was yarded out. For some trees the winch line was pulled out to the log by the choker setter in order to save trees that would be damaged by backing the cat all the way. As can be seen from the map (fig. 1), regeneration units are scattered throughout the stand. Because these unit areas were clear-cut for regeneration, they made ideal transfer points. That is, logs removed by the skid cat were bunched in the regeneration units, and the tractor-arch unit took them on to the landing. With this setup little time was wasted by having the skid cat yard only one or two logs at a time.

The crew consisted of a cat skinner and one choker setter. This crew worked approximately one-third of the time on ground skidding. When ground skidding was not in progress, an angledozer was attached to the skid cat and it was used to pile slash, to build spur roads, to build arch trails, and to prepare and clean landings. The division of time for the skid cat varied for each landing.

Daily production was increased by using the skid cat. However, costs of yarding were somewhat higher in areas where it was used. In 1949 yarding was done by one tractor-arch unit with a cat skinner and two choker setters working all the time, and the skid cat with a cat skinner and one choker setter working only one-third of the time. The average net scale at the landing was 66,000 board feet per 8-hour day. This is a higher daily production than one tractor-arch unit can ordinarily sustain on similar topography in this forest type.

Training and Supervision

Training the logging crew was one of the most important measures in reducing logging damage. Without proper training the other measures outlined in this paper would lose their effectiveness. For example, selecting and marking a route for an arch trail is of little value unless the yarding crew is trained to use the trail. Having a skid cat on the job does not necessarily mean logging damage will be reduced. The crew has to be trained to use it properly.

Both the logging superintendent and the forester made a special effort to acquaint all the workers with the objectives of the project. The loggers were made to understand that their job was reducing damage to advance growth as well as getting out logs. Such specific measures as the use of the skid cat and the logging maps were explained to them. The practices peculiar to each job were discussed with each man, and he was shown how he could contribute most effectively to reducing damage. Other points basic in growing a new crop were explained to show why damage should be reduced: How a tree grows, where the clear boards are obtained, how disease and insects attack scarred trees.

Because their past experience had been in extensive stands of overmature virgin timber, many members of the logging crew were aware only of the need to harvest the existing trees. It was important, therefore, to emphasize the loggers' role in growing a new crop of timber. All these points were discussed with the men at the beginning of the season and whenever new men were hired.

The forester worked with each falling and yarding crew for two or three days at the beginning of the season. This time was used to show the crew how they could save reproduction and do less damage to the larger advance growth. After these first few days he spent about half of his time with the crews or checking on their work. When crews moved to a new landing he distributed the maps and familiarized the cat skinners and choker setters with the arch trails and the ground skidding areas. Frequent checks were made to see that the falling and yarding crews were doing their jobs correctly. At these times advice was given to men needing it and encouragement to those doing a good job.

Discussion

On this experimental logging project reduction of logging damage was accomplished with present types of equipment by preparing and carrying out a detailed logging plan, and by carefully training and supervising the logging crew.

The ultimate in reducing logging damage, however, will require the development of new equipment, or at least the modification of present equipment. The tractor-arch unit causes an unduly large amount of damage to reproduction because of its size and large turning radius. Smaller, more maneuverable yarding equipment is needed.

There is also a need for more extensive use of lines for yarding logs out of thickets of reproduction without sending tractors into the trees. However, the large line necessary for ground skidding the larger logs greatly restricts the use of lines pulled out by hand for this type of work. A skid cat with an auxiliary drum and fairlead similar to the one developed by I. L. Morgan of New Meadows, Idaho[4/] could be used for this purpose. The auxiliary drum allows for the use of a lighter line for winching small logs to the tractor, where they can be transferred to a heavier main line for yarding to the landing. Or possibly the lighter line might be used as a haul-back to pull out a heavier line for winching large logs to the tractor.

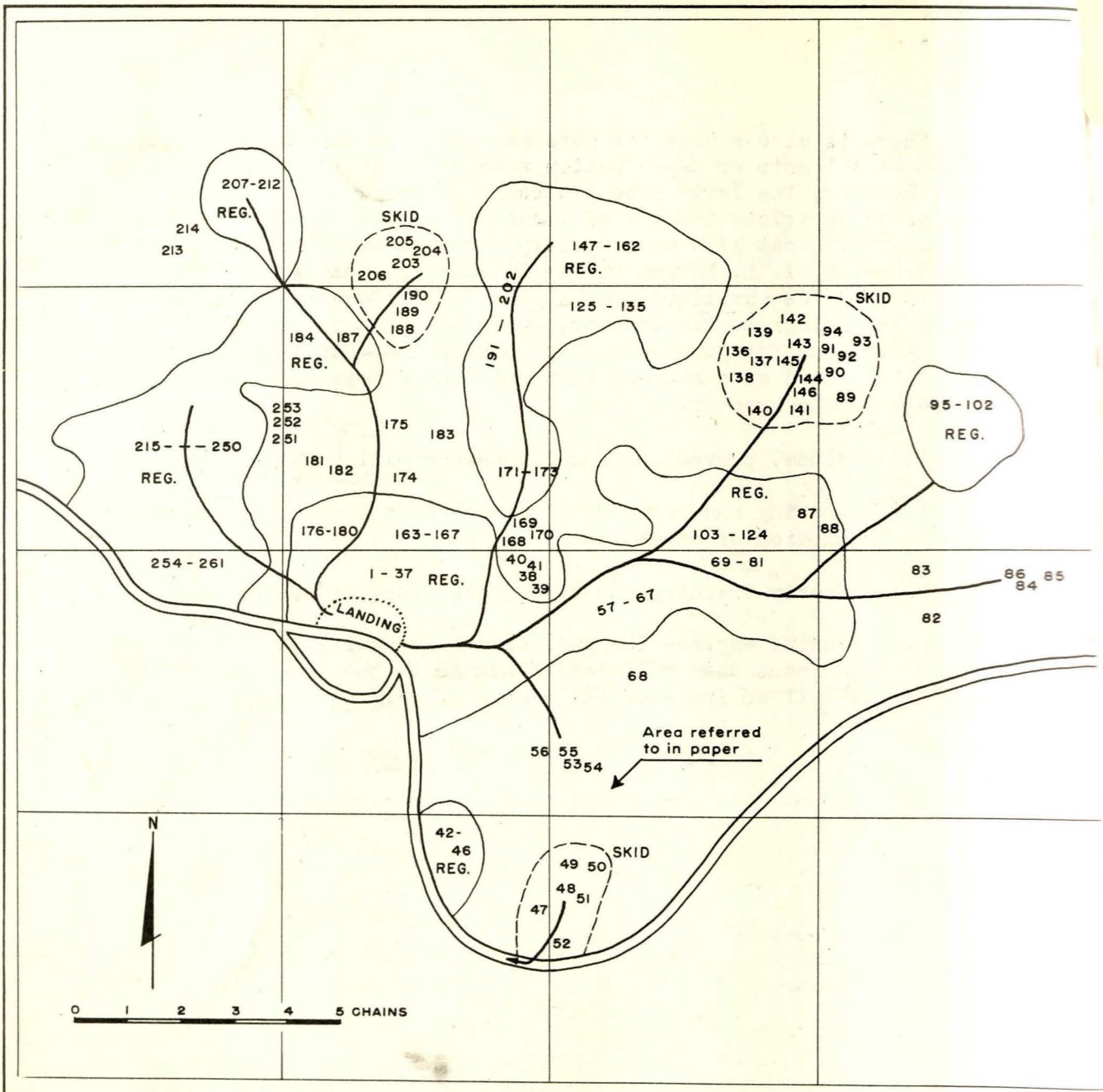
To conclude, preventing logging damage will be made easier by:

1. Preparing and carrying out a detailed logging plan aimed at reduction of damage;

2. Properly training and supervising logging crews; and

3. Focusing engineering and logging ingenuity on designing equipment that will lessen damage to the advance growth as well as increase efficiency of yarding logs.

4/ New device increased production of log skidding tractors. Article in the Lumberman 76(9): 74. September 1949.



LANDING 4

LEGEND

Ground skidding	SKID
Regeneration units	REG
Yarding trails	
Tree location	1, 68, etc.

VOLUMES

Total cut	734 M
To be yarded by arch	630 M
To be yarded by skidcat	104 M
Reserve	566 M

Fig. 1 - Logging map of a typical landing.